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Heavy Metals Concentrations in The Sediment in Rivers and Sea Along Estuary of Kenjeran River in Surabaya

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Abstract

Concentration analysis of heavy metal (Cd, Cr, Cu, Hg and Pb) in the sediment in Tambakwedi, Jeblokan and Kenjeran rivers and sea along Kenjeran river Surabaya using Grab sampling have already done. Samples preparations conducted using Toxicity Characteristic Leaching Procedure (TCLP).

It was found that concentrations of Cadmium (Cd) in Tambakwedi, Jeblokan and Kenjeran rivers sediment are 0,710 ; 0,030 and 0,047 mg/L respectively; concentrations of Chromium (Cr) are 0,533 ; 0,165 and 0,264 mg/L respectively; Copper (Cu) concentrations are 1,144 ; 0,155 and 0,419 mg/L respectively; Mercury (Hg) concentrations are: 0,931 ; 0,699 and 0,822 mg/KL whereas Lead (Pb) concentrations are: 4,545 ; 3,477 and 4,141 mg/L in wet samples respectively.

The research result for heavy metal concentrations in the sediment along estuary of Tambakwedi, Jeblokan and Kenjeran rivers (representatively of the sea) are: for Cd concentrations 0,008 ; 0,025 and 0,028 mg/L respectively; Cr concentrations are 0,319 ; 0,096 and 0,115 mg/L respectively; Cu concentrations are 0,004 ; 0,009 and 0,113 mg/L; Hg concentrations are 0,049 ; 0,415 and 0,507 mg/L and for Pb concentrations are: 0,288 ; 2,516 and 2,887 mg/L in wet samples respectively.

Some of the value of heavy metal concentrations results lower than the requirement of TCLP Standard Value of Government Regulation No.85, 1999 which it's concerning in Management of Dangerous and Poisonous Material, exept Hg concentration. Indeed, the standard concentrations value of Cd, Cr, Cu, Hg and Pb are1,0;5,0; 10,0; 0,2 and 5,0 mg/L. Mercury pollution probably happened because of the presence of plants industry along the Tambak Wedi, Jeblokan and Kenjeran river.

Key words: Kenjeran, sediment, heavy metals

Introduction

Heavy metal pollution in the seashore area is depending on river content which is estuary in thus sea. Ririn et al. (2000) reported, in Tambak Wedi's estuary, Surabaya, concentration of Cd (Cadmium) and Pb (Lead) was 0,035 and 2,536 ppm respectively, whereas 0,075 and 0,390 ppm was reported for the Cd and Pb concentration in the sea water. Clams were used as bioindicator, they are *Mytilus viridis* L. and *Solen grandis*. It was found that Cd and Pb content are 0,7839 μg/g and 0,4016 μg/g respectively. And 3,7 μg/g and 1,2 μg/g was reported for wet weight [1]. For food requirements according to WHO/FAO are, Cd content 1 μg/g and 2 μg/g for Pb content. It concluded that *Mytilus viridis* L. while *Solen grandis* beyond the requirement. Prigi, A. reported that Cu (Cuprum) and Hg (Mercury) content in human blood in Kenjeran/Sukolilo area are 511,07 ppb and 2,48 ppb respectively [2]. Thus heavy metal concentration beyond the limit values which is WHO/FAO defined. Prigi, A. also reported that mother breastfeeding (ASI) and mothers blood in Kenjeran area were content heavy metals such as Pb, Cd and Hg in high concentration beyond the limit values. Thus phenomena are happened, probably, because of the sea biota which is content heavy metal are eaten by mothers. Atiek, 1995 reported that fishes and clams on Kenjeran area are polluted by Cd, so do the human blood in thus area [3]. The phenomena which is Prigi, A. reported also happened in Kenjeran area.

Ririn et. al. (2005)[4] reported Cd, Cr, Cu, Hg and Pb content on river water and Kenjeran sea by doing river and sea water sampling around the Tambak Wedi estuary, Jeblokan duct and Kenjeran river respectively. The results are: Cd content: 0,008; 0,024 dan 0,028 mg/L, Cr: 0,062; 0,097 and 0,135 mg/L, Cu content: 0,479; 0,648 and 0,366 mg/L, Hg content: 2,479; 0,648 and2,004 mg/L, while Pb content: 12,196; 1,760 and 9,368 mg/ L. Cd, Cr, Cu, Hg and Pb contents on river water were beyond the water quality requirement (class III), Regulation of Surabaya City Area No.02, 2004 [5]. Thus regulation required 0,01; 0,05; 0,02; 0,002 and

0,03 mg/L for concentration Cd, Cr, Cu, Hg and Pb respectively.

Sea water concentrations of Cd around Tambak Wedi river estuary, Jeblokan canal and Kenjeran river are 0,064; 0,007 dan 0,097 mg/L respectively. Cr concentrations are 0,530; 0,135 and 0,473 mg/L. Cu concentrations are 0,238; 0,024 and 0,389 mg/L. Hg concentrations are 1,028; 0,0,81 and 2,119 mg /L, while Pb concentrations are 6,082; 2,261 and 9,656 mg/L. Cd, Cr, Cu, Hg and Pb concentration in sea water are over the limit value which is stated by Ministry of Environmental No. 51, 2004 [6]. Maksimum concentrations for Cd, Cr, Cu, Hg and Pb are limited on 0,01; 0,05; 0,02; 0,002 and 0,03 mg/ respectively.

Wherein an area has been polluted by heavy metal in high concentration, sea and river sediment probably content heavy metal in high concentration, thus phenomenon will be effect on the sea biota. Sea biota will be have high probability on having high concentration of heavy metal. Depend on thus phenomenon, this research conducted to knowing the heavy metal concentration (Cd, Cr, Cu, Hg and Pb) in sediment on Kenjeran seashore, Surabaya. Quality standard value, especially, for sediment sample are not present, because of it we used quality standard value TCLP pollution compounds based on Indonesia Goverment Regulation No.85, 1999 [7]. This research also collect data industries which drainage his waste water along Tambak Wedi river, Jeblokan canal and Kenjeran river, and analyzed metals which is potentially as a source of pollutant.

Heavy metal concentration determined using Inductively Coupled Plasma Spectrometer (ICPS). Validation method (parameter selectivity, linierity, limit detection value, limit quantitation value, precision and accuration) was done prior sample analyzed.

Experimental Method

Materials

River and sea sediment (sludge) around Tambak Wedi river, Jeblokan canal and Kenjeran river was sampled. Sample was taken on 03 October 2005, start at 09.00 AM using Grab sampling method in order to get representation of concentration of heavy metal (Cd, Cu, Cr, Hg and Pb). Sampling area showed in ANNEX I.

Chemical Reagent

Standard using Cd, Cr, Cu, Hg and Pb in HNO_3 0,5 Mol/L. Chemical reagents are HNO_3, H_2SO_4, HCl, H_2O_2 reagent grade; filter paper Whatman No. 41 and 42; and aquademineralisata .

Devices

Inductively Coupled Plasma Spectrometer (ICPS) ARL-3410+ Fisons, glass laboratory apparatus; glass filter crucible, salimeter (Atago), and GPS (Geo Positioning System).

Results and Discussion

Trade and Industrial Department (Disperindag) Kotamadya Surabaya reported, they are several industries along Tambak Wedi river, Jeblokan canal and Kenjeran river which is drainage his wastewater into them. Industries's wastewater potential represented in Table 1.

Table 1 Industries along Tambak Wedi river, Jeblokan canal and Kenjeran river with his wastewater potential content

No	Kind of Industry	*Drainage area*			Wastewater potential content
		Tambak Wedi river	Jeblokan duct	Kenjeran river	
1	Jewelry (metal)	1	1	2	Hg, Cr, Cu
2	Plastic	8	4	5	Cd, Pb, Sb, Sn, Zn
3	Cosmetic	3	1	5	Zn
4	Sablon	-	1	-	Pb
5	Thiner-Paint	3	2	3	As, Ba, Cd, Cr, Pb, Hg, Ag, Zn, Se
6	Printing	12	10	17	Cr dan Pb
7	Motor components vehicle	-	2	8	As, Ba, Cd, Cr, Pb, Ag, Hg, Cu, Ni, Zn, Se, Sn
8	Housewares (metal)	-	12	1	
9	Electronic components	-	-	2	As, Ba, Cd, Cr, Pb, Ag, Hg, Cu, Ni, Zn, Se, Sn, Sb
10	Bottle welding	-	-	1	Pb, Cd, Cr, Co, Ni, Ba
11	Colouring	1	-	-	Cr, Zn, Pb, Hg, Ni, Sn, Cu, Sb, Ba
12	Others	-	1	2	-
	TOTAL	30	35	48	

Table 1 above showed, that wastewater which is drainage to the river was content heavy metal, thus metal content make the river polluted and so does the seashore. Because of thus reason, the sediment sample was taken first from river and sea water. Before sample analysed, validation method (parameter: selectivity, linierity, limit detection value, limit quantitation value, precision and accuration) was done. Selectivity done on wave lenght which are metal are not interference each other. They are : λ_{Cd} = 228,802 nm; λ_{Cr} = 283,563 nm; λ_{Cu} = 327,396 nm; λ_{Hg} = 253,652 nm and λ_{Pb} = 283,306 nm. The other parameters (selectivity, linierity, limit detection value, limit quantitation value, precision and accuration) are fulfill the requirements.

Sediment samples from river and sea around the Tambak Wedi estuary, Jeblokan canal and Kenjeran river was taken on several position area as follows :

a. River estuary is position 1, and next location of sampling is 1 km from position 1 to the river (position 2). Thus positions represent river water.
b. 1 km from position 1 to the north of the seashore is position 3, and next location (position 4) is 1 km from the left side of position 3, while 1 km from the right side of position 3 is position 5. Position 3, 4, and 5 represent sea water.

Heavy metal analyzed results presented on Table 2.

Table 2. Heavy metals concentration (Cd, Cr, Cu, Hg and Pb) in sea and river sediment Tambak Wedi river, Jeblokan canal, Kenjeran river, Baluran National Park, Banyuwangi and Pagerungan Seashore, Madura

Sampling location	Concentration (mg/L)									
	River sediment					Sea sediment				
	Cd	Cr	Cu	Hg	Pb	Cd	Cr	Cu	Hg	Pb
Tambak Wedi river	0,71	0,533	1,144	0,931	4,545	0,008	0,319	0,004	0,049	0,288
Jeblokan duct	0,030	0,165	0,155	0,699	3,477	0,025	0,096	0,009	0,415	2,516
Kenjeran river	0,047	0,264	0,419	0,822	4,141	0,028	0,115	0,113	0,507	2,887
Quality standard of TCLP	1,0	5,0	10,0	0,2	5,0	1,0	5,0	10,0	0,2	5,0
Baluran National Park						0,031	0,189	0,080	0,269	6,360
Pagerungan Seashore						0,321	5,792	1,873	0,873	36,730

*results are average value from triplicate sample analyzed

Sediment from Baluran National Park and Pagerungan seashore, Madura were used as the comparison. The results showed that Hg and Pb content on Baluran National Park's sediment were beyond the quality standard value, while Pagerungan seashore's sediment beyond the quality standard value for all heavy metals which are analyzed (**Table 2**). In order that results, we couldnot used thus sediment as an comparison.

Some of the value of heavy metal concentrations results lower than the requirement of TCLP Standard Value of Government Regulation No.85, 1999 which it's concerning in Management of Dangerous and Poisonous Material, exept Hg concentration. Indeed, the standard concentrations value of Cd, Cr, Cu, Hg and Pb are1,0;5,0; 10,0; 0,2 and 5,0 mg/L.

Table1 showed, Tambak Wedi river passed by 4 industrys are potential as a Mercury pollutant sources. Jeblokan canal also have 17 industrys wich have a drainage and Kenjeran river have 16 industrys. All of that industrys are potential as a Mercury pollutant sources.

Mercury pollution probably happened because of the presence of plants industry along the Tambak Wedi, Jeblokan and Kenjeran river.

Conclussions

1. Cd, Cr, Cu and Pb content on sediment of Tambak Wedi river, Jeblokan canal, and Kenjeran river were below the quality standard of TCLP on **Indonesia Goverment Regulation No 85 ,1999,** except Hg.
2. Mercury (Hg) content on water and sea sediment, mainly, because of the waste water industries drainage along the river/canal.

Rerefences

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ANNEX

Map of Sampling Location